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<110> IMAMURA, Jun  
YANAGIDATE, Ritsuko  
SAKAI, Takako  
FUJIMOTO, Hideya  
KOIZUKA, Nobuya  
HAYAKAWA, Takahiko

<120> A Protein Which is Involved in Recovery of Cytoplasm Male  
Fertility from Sterility and a Gene Encoding the Protein

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<140> US 10/613,053

<141> 2003-07-07

<150> PCT JP02/04092

<151> 2002-04-24

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<170> PatentIn version 3.2

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Asp Ala Gln Asn Leu Phe Thr Glu Met Gln Glu Lys Gly Ile Phe Pro  
275 280 285

Asp Leu Phe Thr Tyr Asn Ser Met Ile Val Gly Phe Cys Ser Ser Gly  
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Arg Trp Ser Asp Ala Glu Gln Leu Leu Gln Glu Met Leu Glu Arg Lys  
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Ile Ser Pro Asp Val Val Thr Tyr Asn Ala Leu Ile Asn Ala Phe Val  
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Lys Glu Gly Lys Phe Phe Glu Ala Glu Glu Leu Tyr Asp Glu Met Leu  
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Gly Phe Cys Lys Gln Asn Arg Leu Asp Ala Ala Glu His Met Phe Tyr  
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Leu Met Ala Thr Lys Gly Cys Ser Pro Asn Leu Ile Thr Phe Asn Thr  
 385 390 395 400

Leu Ile Asp Gly Tyr Cys Gly Ala Lys Arg Ile Asp Asp Gly Met Glu  
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Leu Leu His Glu Met Thr Glu Thr Gly Leu Val Ala Asp Thr Thr Thr  
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Tyr Asn Thr Leu Ile His Gly Phe Tyr Leu Val Gly Asp Leu Asn Ala  
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Ala Leu Asp Leu Leu Gln Glu Met Ile Ser Ser Gly Leu Cys Pro Asp  
 450 455 460

Ile Val Thr Cys Asp Thr Leu Leu Asp Gly Leu Cys Asp Asn Gly Lys  
 465 470 475 480

Leu Lys Asp Ala Leu Glu Met Phe Lys Val Met Gln Lys Ser Lys Lys  
 485 490 495

Asp Leu Asp Ala Ser His Pro Phe Asn Gly Val Glu Pro Asp Val Gln  
 500 505 510

Thr Tyr Asn Ile Leu Ile Ser Gly Leu Ile Asn Glu Gly Lys Phe Leu  
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Glu Ala Glu Glu Leu Tyr Glu Glu Met Pro His Arg Gly Ile Val Pro  
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Arg Leu Asp Glu Ala Thr Gln Met Phe Asp Ser Met Gly Ser Lys Ser  
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Lys Ala Gly Arg Val Asp Asp Gly Leu Glu Leu Phe Cys Glu Met Gly  
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Arg Arg Gly Ile Val Ala Asn Ala Ile Thr Tyr Ile Thr Leu Ile Cys  
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Gly Phe Arg Lys Val Gly Asn Ile Asn Gly Ala Leu Asp Ile Phe Gln  
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Glu Met Ile Ser Ser Gly Val Tyr Pro Asp Thr Ile Thr Ile Arg Asn  
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| ccgtttgtac tttatctctc gtttattttc tcagtcacga gtttttttta gagatcgacg | 780  |
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| tttgatcaat gcatttgtca aggaaggcaa gttctttgag gctgaagaat tatacgatga | 1860 |
| gatgcttcca aggggtataa tccctaatac aatcacatat agttcaatga tcgatggatt | 1920 |
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| gcaggttttg gaggagagag tttgaagctg caaagtgggt ttcataaaat caaaggttta  | 180 |
| gaggatgcga ttgatttggt cagtgcacatg cttcgatctc gtcctttacc ttctgtggtt | 240 |
| gatttctgta aattgatggg tgtgggtggg agaatggaac gcccgatct tgtgatttct   | 300 |
| ctctatcaga agatggaaa gaaacagatt cgatgtgata tatacagctt caatattctg   | 360 |
| ataaaatgtt tctgcagctg ctctaagctc ccctttgctt tgtctacatt tggtaagctc  | 420 |
| accaagcttg gactccacc tgatgttggt accttcacca cctgctcca cggattgtgc    | 480 |
| gtggaagata gggtttctga agctttgaat ttgtttcatc aaatgtttga aacgacatgt  | 540 |
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Lys Leu Gln Ser Gly Phe His Glu Ile Lys Gly Leu Glu Asp Ala Ile  
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Asp Leu Phe Ser Asp Met Leu Arg Ser Arg Pro Leu Pro Ser Val Val  
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Asp Phe Cys Lys Leu Met Gly Val Val Val Arg Met Glu Arg Pro Asp  
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Leu Val Ile Ser Leu Tyr Gln Lys Met Glu Arg Lys Gln Ile Arg Cys  
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Asp Ile Tyr Ser Phe Asn Ile Leu Ile Lys Cys Phe Cys Ser Cys Ser  
115 120 125

Lys Leu Pro Phe Ala Leu Ser Thr Phe Gly Lys Leu Thr Lys Leu Gly  
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Leu His Pro Asp Val Val Thr Phe Thr Thr Leu Leu His Gly Leu Cys  
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Val Glu Asp Arg Val Ser Glu Ala Leu Asn Leu Phe His Gln Met Phe  
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Glu Thr Thr Cys Arg Pro Asn Val Val Thr Phe Thr Thr Leu Met Asn  
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Gly Leu Cys Arg Glu Gly Arg Ile Val Glu Ala Val Ala Leu Leu Asp  
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Arg Met Met Glu Asp Gly Leu Gln Pro Thr Gln Ile Thr Tyr Gly Thr

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|   | 245 |     | 250 | 255     |
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|   | 260 |     | 265 | 270     |
| Asp Ala Gln Asn Leu Phe Thr Glu Met Gln Glu Lys Gly Ile Phe Pro |     |     |     |         |
|   | 275 |     | 280 | 285     |
| Asp Leu Phe Thr Tyr Asn Ser Met Ile Val Gly Phe Cys Ser Ser Gly |     |     |     |         |
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| Arg Trp Ser Asp Ala Glu Gln Leu Leu Gln Glu Met Leu Glu Arg Lys |     |     |     |         |
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| Ile Ser Pro Asp Val Val Thr Tyr Asn Ala Leu Ile Asn Ala Phe Val |     |     |     |         |
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| Lys Glu Gly Lys Phe Phe Glu Ala Glu Glu Leu Tyr Asp Glu Met Leu |     |     |     |         |
|   | 340 |     | 345 | 350     |
| Pro Arg Gly Ile Ile Pro Asn Thr Ile Thr Tyr Ser Ser Met Ile Asp |     |     |     |         |
|   | 355 |     | 360 | 365     |
| Gly Phe Cys Lys Gln Asn Arg Leu Asp Ala Ala Glu His Met Phe Tyr |     |     |     |         |
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| Tyr Asn Thr Leu Ile His Gly Phe Tyr Leu Val Gly Asp Leu Asn Ala |     |     |     |         |
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| Ala Leu Asp Leu Leu Gln Glu Met Ile Ser Ser Gly Leu Cys Pro Asp |     |     |     |         |
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Thr Tyr Asn Ile Leu Ile Ser Gly Leu Ile Asn Glu Gly Lys Phe Leu  
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Arg Arg Gly Ile Val Ala Asn Ala Ile Thr Tyr Ile Thr Leu Ile Cys  
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Gly Phe Arg Lys Val Gly Asn Ile Asn Gly Ala Leu Asp Ile Phe Gln  
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Glu Met Ile Ser Ser Gly Val Tyr Pro Asp Thr Ile Thr Ile Arg Asn  
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| catgagatga ctgaagcagg attagttgct aacacagtta cttacaacac tcttattcac    | 1320 |
| gggtttttgtc aggtgggcga tcttactgct gctctagacc ttctacatga gatgatttct   | 1380 |
| agtgggtgtgt gccctaattgt cgttacttgt agcactttgc tggatgggtct ctgcgataac | 1440 |
| gggaaactaa aagatgcatg ggaactgttt aaggttatgc agaagagtaa gatggatctt    | 1500 |
| gatgctagtc accccttcaa tgggtgtggaa cctgatgttc aaacttacia tatattgatc   | 1560 |
| agcggcttga tcaatgaagg gaagttttta gaggctgagg aattatacaa ggagatgccc    | 1620 |
| cacaggggta tagtcccaga tactattacc tatagctcaa tgatcgatgg actatgcaag    | 1680 |
| cagagccgcc tggatgaggc tacacaaatg tttgattcga tgggtagcaa gagcttctct    | 1740 |

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ccaaacgtag tgacctttac tacactcatt gatggctact gtaaagcagg aagggttgat 1800
gatgggctgg agcttttctg cgagatgggt agaagagga tagttgctaa tacaattact 1860
tacatcactt tgattcgtgg ttttcgcaat gtgggtaata ttaatggggc tctagacatt 1920
ttccaggaga tgatttcaag tgggtgtgtat cctgggtatca ttactatccg cagtatgctg 1980
actggtttat ggagtaaaga ggaactaaaa aggacagtgg caatgcttga ggaactgcag 2040
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<210> 19
<211> 691
<212> PRT
<213> Raphanus sativus

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<220>
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<223> Xaa can be any naturally occurring amino acid

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<220>
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<223> Xaa can be any amino acid

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<400> 19

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Met Leu Ala Arg Val Cys Gly Phe Lys Cys Ser Ser Ser Pro Ala Val
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Ser Ala Ala Arg Leu Phe Cys Thr Arg Ser Ile Arg Asp Thr Leu Ala
20          25          30

```

```

Lys Ala Ser Arg Asp Gly Glu Ser Cys Glu Ala Gly Phe Gly Gly Glu
35          40          45

```

```

Ser Leu Lys Leu Gln Ser Gly Phe His Glu Ile Lys Gly Leu Glu Asp
50          55          60

```

```

Ala Ile Asp Leu Phe Ser Asp Met Leu Arg Ser Arg Pro Leu Pro Ser
65          70          75          80

```

```

Val Val Asp Phe Cys Lys Leu Met Gly Val Val Val Arg Met Lys Arg
85          90          95

```

```

Pro Asp Val Val Ile Ser Leu His Lys Lys Met Glu Met Arg Arg Ile
100         105         110

```

```

Pro Cys Asp Ala Tyr Ser Phe Asn Ile Leu Ile Lys Cys Phe Cys Ser
115         120         125

```

Cys Ser Lys Leu Pro Phe Ala Leu Ser Thr Phe Gly Lys Leu Thr Lys  
130 135 140

Leu Gly Leu His Pro Asp Val Val Thr Phe Thr Thr Leu Leu His Gly  
145 150 155 160

Leu Cys Val Glu Asn Arg Gly Ser Glu Ala Leu Asn Leu Phe His Gln  
165 170 175

Met Phe Glu Thr Thr Cys Arg Pro Asn Val Val Thr Phe Thr Thr Leu  
180 185 190

Met Asn Gly Leu Cys Arg Glu Gly Arg Ile Val Glu Ala Val Ala Leu  
195 200 205

Leu Asp Arg Met Met Glu Asp Gly Leu Gln Pro Thr Gln Ile Thr Tyr  
210 215 220

Gly Thr Ile Val Asp Gly Met Cys Lys Lys Gly Asp Thr Val Ser Ala  
225 230 235 240

Leu Asn Leu Leu Arg Lys Met Glu Glu Val Ser His Ile Ile Pro Asn  
245 250 255

Val Val Ile Tyr Ser Ala Ile Ile Asp Ser Leu Cys Lys Asp Gly Arg  
260 265 270

His Ser Asp Ser Gln Asn Leu Phe Thr Glu Met Gln Glu Lys Gly Ile  
275 280 285

Phe Pro Asp Leu Phe Thr Tyr Asn Cys Met Ile Asn Gly Phe Cys Ser  
290 295 300

Ser Gly Arg Trp Ile Asp Ala Glu Gln Leu Leu Gln Glu Met Leu Glu  
305 310 315 320

Arg Lys Ile Ser Pro Asp Val Val Thr Tyr Asn Ala Leu Ile Asn Ala  
325 330 335

Phe Val Lys Glu Gly Lys Phe Phe Glu Ala Glu Glu Leu Tyr Asp Glu  
340 345 350

Met Leu Pro Arg Gly Ile Ile Pro Asn Thr Ile Thr Tyr Ser Ser Met  
355 360 365

Ile Asp Gly Phe Cys Lys Gln Asn Arg Leu Asp Ala Ala Glu His Met  
370 375 380

Phe Tyr Leu Met Pro Thr Lys Gly Cys Ser Pro Asp Val Phe Thr Phe  
385 390 395 400

Asn Thr Leu Ile Asp Gly Tyr Arg Gly Ala Lys Arg Ile Asp Asp Gly  
405 410 415

Met Glu Leu Leu His Glu Met Thr Glu Ala Gly Leu Val Ala Asn Thr  
420 425 430

Val Thr Tyr Asn Thr Leu Ile His Gly Phe Cys Gln Val Gly Asp Leu  
435 440 445

Thr Ala Ala Leu Asp Leu Leu His Glu Met Ile Ser Ser Gly Val Cys  
450 455 460

Pro Asn Val Val Thr Cys Ser Thr Leu Leu Asp Gly Leu Cys Asp Asn  
465 470 475 480

Gly Lys Leu Lys Asp Ala Trp Glu Leu Phe Lys Val Met Gln Lys Ser  
485 490 495

Lys Met Asp Leu Asp Ala Ser His Pro Phe Asn Gly Val Glu Pro Asp  
500 505 510

Val Gln Thr Tyr Asn Ile Leu Ile Ser Gly Leu Ile Asn Glu Gly Lys  
515 520 525

Phe Leu Glu Ala Glu Glu Leu Tyr Lys Glu Met Pro His Arg Gly Ile  
530 535 540

Val Pro Asp Thr Ile Thr Tyr Ser Ser Met Ile Asp Gly Leu Cys Lys  
545 550 555 560

Gln Ser Arg Leu Asp Glu Ala Thr Gln Met Phe Asp Ser Met Gly Ser  
565 570 575

Lys Ser Phe Ser Pro Asn Val Val Thr Phe Thr Thr Leu Ile Asp Gly  
580 585 590

Tyr Cys Lys Ala Gly Arg Val Asp Asp Gly Leu Glu Leu Phe Cys Glu  
595 600 605

Met Gly Arg Arg Gly Ile Val Ala Asn Thr Ile Thr Tyr Ile Thr Leu  
610 615 620

Ile Arg Gly Phe Arg Asn Val Gly Asn Ile Asn Gly Ala Leu Asp Ile  
625 630 635 640

Phe Gln Glu Met Ile Ser Ser Gly Val Tyr Pro Gly Ile Ile Thr Ile  
645 650 655

Arg Ser Met Leu Thr Gly Leu Trp Ser Lys Glu Glu Leu Lys Arg Thr  
660 665 670

Val Ala Met Leu Glu Glu Leu Gln Met Ser Val Gly Tyr Gln Leu Glu  
675 680 685

Asp Glu Xaa  
690

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<212> DNA  
<213> Raphanus raphanistrum

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ctttgctttg tctacatttg gtaagatcac caagcttgga ctccaccctg atgttgctac 180  
cttcaacacc ctgctccacg gattatgtct tgataagagg gtttctgaag ccttggaattt 240  
gtttcatcaa atgtttgaaa cgacatgtag gccgaacatc ataacgttta ccacgctgat 300  
gaacggtctt tgctacgagg gtagagttgt cgaagctgta gctctgcttg atcggatgct 360  
agaagatggg ctccagcctg accagattac ttacggaaca attgtagacg ggatgtgtaa 420  
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caaacccaat gtggtaatct atagtgccat cattga 516

<210> 21  
<211> 171  
<212> PRT  
<213> Raphanus raphanistrum

<400> 21

Met Glu Arg Pro Asp Leu Val Ile Ser Leu Tyr Gln Lys Met Glu Arg  
1 5 10 15

Lys Gln Ile Pro Cys Asp Val Tyr Ser Phe Asn Ile Leu Ile Lys Cys

|     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
|     | 20  |     | 25  |     | 30  |     |     |     |     |     |     |     |     |     |     |
| Phe | Cys | Ser | Cys | Ser | Lys | Leu | Pro | Phe | Ala | Leu | Ser | Thr | Phe | Gly | Lys |
|     | 35  |     |     |     |     | 40  |     |     |     |     | 45  |     |     |     |     |
| Ile | Thr | Lys | Leu | Gly | Leu | His | Pro | Asp | Val | Ala | Thr | Phe | Asn | Thr | Leu |
| 50  |     |     |     |     | 55  |     |     |     |     |     | 60  |     |     |     |     |
| Leu | His | Gly | Leu | Cys | Leu | Asp | Lys | Arg | Val | Ser | Glu | Ala | Leu | Asp | Leu |
| 65  |     |     |     |     | 70  |     |     |     |     | 75  |     |     |     |     | 80  |
| Phe | His | Gln | Met | Phe | Glu | Thr | Thr | Cys | Arg | Pro | Asn | Ile | Ile | Thr | Phe |
|     |     |     | 85  |     |     |     |     |     | 90  |     |     |     |     | 95  |     |
| Thr | Thr | Leu | Met | Asn | Gly | Leu | Cys | Tyr | Glu | Gly | Arg | Val | Val | Glu | Ala |
|     |     |     | 100 |     |     |     |     | 105 |     |     |     |     | 110 |     |     |
| Val | Ala | Leu | Leu | Asp | Arg | Met | Leu | Glu | Asp | Gly | Leu | Gln | Pro | Asp | Gln |
|     |     | 115 |     |     |     |     | 120 |     |     |     |     | 125 |     |     |     |
| Ile | Thr | Tyr | Gly | Thr | Ile | Val | Asp | Gly | Met | Cys | Lys | Met | Gly | Asp | Thr |
| 130 |     |     |     |     |     | 135 |     |     |     |     | 140 |     |     |     |     |
| Val | Ser | Ala | Leu | Asn | Leu | Leu | Arg | Lys | Met | Glu | Glu | Leu | Ser | His | Ile |
| 145 |     |     |     |     | 150 |     |     |     |     | 155 |     |     |     |     | 160 |
| Lys | Pro | Asn | Val | Val | Ile | Tyr | Ser | Ala | Ile | Ile |     |     |     |     |     |
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<210> 22  
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 <212> DNA  
 <213> Raphanus

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| ttgttctgta cgagatcgat tcgtgatact ctggccaagg caagcrgrga krnnnnnnngt   | 120 |
| tgcgaagcag gttttggagg agagagtttg aagctgcaaa gtgggtttca tgaaatcaaa    | 180 |
| ggtttagagg atgcgattga tttgttcagt gacatgcttc gatctcgtcc tttaccttct    | 240 |
| gtggttgatt tctgtaaaatt gatgggtgtg gtggtgagra tgraacgccc ggatsttgtg   | 300 |

|  |      |
|--|------|
| atttctctcy atmaraagat ggaaakgmrr crsattcsat gtgatriyata cagcttyaat | 360  |
| attctgataa artgtttctg cagytgctct aagctbccct ttgctttgtc tacatttggt  | 420  |
| aagmtcacca agcttgact ccaccctgat gttgytacct tcamcaccct kctccayggá   | 480  |
| ttrtgystkg awrakagggk ttctgaagcy ttgratttkt ttcacaaat gtttgaaacg   | 540  |
| rcatgtaggc csaayrtcrt aacsttyacc ackytgatga acggtctttg cyrcgagggt  | 600  |
| agarttgctg aagcygtagc tctrcttgat cggatgmtrg aagatggctc ccagcctrmc  | 660  |
| cagattactt ayggaacaat ygtagayggg atgtgtaaga wgggagayac tgtgtctgca  | 720  |
| ytgaatctkc tgaggaagat ggaggagktg agccacatca waccaatgt kgtaatctat   | 780  |
| agtgcmatca ttgatagcct ttgtaaagac ggacgtcata gcgatkcwca aaatcttttc  | 840  |
| actgaaatgc aagagaaagg aatctttccm gatttattta cctacaacwg tatgatmrwy  | 900  |
| ggkttttgta gctctggtag atggakcgac gcggagcagt tgttgcaaga aatgttagaa  | 960  |
| aggaagatca gccctgatgt tgtaacttat aatgctttga tcaatgcatt tgtcaaggaa  | 1020 |
| ggcaagttct ttgaggctga agaattatac gatgagatgc ttccwagggg tataatccct  | 1080 |
| aatacaatca catatagttc aatgatcgat ggattttgca aacagaatcg tcttgatgct  | 1140 |
| gctgagcaca tgttttatth gatgsctacc aagggtctgt ctccsracst awtcactttc  | 1200 |
| aatactctca tagacggata tygtggggct aagaggatag atgatggaat ggaacttctc  | 1260 |
| catgagatga ctgaarcagg attagttgct racacaryta cttacaacac tcttattcac  | 1320 |
| gggttytrtc wgggtgggca tcttamtgct gctctagacc ttytacawga gatgatyctt  | 1380 |
| agtggtktgt gccctratrt cgttacttgt rrcactttgc tggatggctc ctgcgataay  | 1440 |
| gggaaactaa aagatgcatk ggaamtgttt aaggttatgc agaagagtaa gawggatctt  | 1500 |
| gatgctagtc accccttcaa tgggtgtggaa cctgatgttc aaacttacia tatattgatc | 1560 |
| agcggcttga tcaatgaagg gaagttttta gaggygagg aattatacra ggagatgccc   | 1620 |
| cacaggggta tagtcccaga tactatyacc tatagctcaa tgatcgatgg aytatgcaag  | 1680 |
| cagagccgcc trgatgaggc tacacaaatg tttgattcga tgggtagcaa gagcttctct  | 1740 |
| ccaaacgtag tgacctttac tacactcatt ratggctact gtaargcagg aagggttgat  | 1800 |
| gatgggctgg agcttttctg cgagatgggt mgaagagga tagttgctaa yrcaattact   | 1860 |
| tacatcactt tgattygtgg ttttcgyaaw gtgggtaata ttaatggggc tctagacatt  | 1920 |
| ttccaggaga tgatttcaag tgggtgtgtat cctgrtayca ttacyatccg cartatgctg | 1980 |
| actggtttat ggagtaaaga ggaactaaaa aggrcagtg caatgcttga graactgcag   | 2040 |
| atgagtrtgg rkywwymrtt kgrggrwkra tga                               | 2073 |

<210> 23  
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 <212> DNA  
 <213> Raphanus

<220>  
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 <223> n can be any nucleotide

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 attctgataa artgtttctg cagctgctct aagctscct ttgctttgtc tacatttggt 420  
 aagmtcacca agcttggact ccaccctgat gttgttacct tcaccaccct kctccaygga 480  
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 agaattgtcg aagccgtagc tctrcttgat cggatgatgg aagatggtct ccagcctacc 660  
 cagattactt atggaacaat cgtagatggg atgtgtaaga agggagatac tgtgtctgca 720  
 ctgaatctgc tgaggaagat ggaggagggtg agccacatca tacccaatgt tgtaatctat 780  
 agtgcaatca ttgatagcct ttgtaaagac ggacgtcata gcgatkwcga aaatcttttc 840  
 actgaaatgc aagagaaaagg aatctttccm gatttattta cctacaacwg tatgatmrwy 900  
 ggkttttgta gctctggtag atggakcgac gcggagcagt tgttgcaaga aatgttagaa 960  
 aggaagatca gccctgatgt tgtaacttat aatgctttga tcaatgcatt tgtcaaggaa 1020  
 ggcaagttct ttgaggctga agaattatac gatgagatgc ttccwagggg tataatccct 1080  
 aatacaatca catatagttc aatgatcgat ggattttgca aacagaatcg tcttgatgct 1140  
 gctgagcaca tgttttatth gatgsctacc aagggtctgt ctccsracst awtcactttc 1200  
 aatactctca tagacggata tygtggggct aagaggatag atgatggaat ggaacttctc 1260  
 catgagatga ctgaarcagg attagttgct racacaryta cttacaacac tcttattcac 1320  
 gggttytrtc wgggtggcgga tcttamtgct gctctagacc ttytacawga gatgatyctt 1380  
 agtggtktgt gccctratrt cgttacttgt rrcactttgc tggatggtct ctgcgataay 1440  
 gggaaactaa aagatgcatk ggaamtgttt aaggttatgc agaagagtaa gawggatctt 1500

|            |            |            |            |            |            |      |
|------------|------------|------------|------------|------------|------------|------|
| gatgctagtc | accccttcaa | tggtgtggaa | cctgatgttc | aaacttacia | tatattgatc | 1560 |
| agcggcttga | tcaatgaagg | gaagttttta | gaggcygagg | aattatacra | ggagatgccc | 1620 |
| cacaggggta | tagtcccaga | tactatyacc | tatagctcaa | tgatcgatgg | aytatgcaag | 1680 |
| cagagccgcc | trgatgaggc | tacacaaatg | tttgattcga | tgggtagcaa | gagcttctct | 1740 |
| ccaaacgtag | tgacctttac | tacactcatt | ratggctact | gtaargcagg | aagggttgat | 1800 |
| gatgggctgg | agcttttctg | cgagatgggt | mgaagagga  | tagttgctaa | yrcaattact | 1860 |
| tacatcactt | tgattygtgg | ttttcgyaaw | gtgggtaata | ttaatggggc | tctagacatt | 1920 |
| ttccaggaga | tgatttcaag | tggtgtgtat | cctgrtayca | ttacyatccg | cartatgctg | 1980 |
| actggtttat | ggagtaaaga | ggaactaaaa | aggrcagtgg | caatgcttga | graactgcag | 2040 |
| atgagtrtgg | rkywwymrtt | kgrggrwkra | tga        |            |            | 2073 |

<210> 24  
 <211> 2064  
 <212> DNA  
 <213> Raphanus

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| ttgttctgta | cgagatcgat tctgtatact ctggccaagg caagcggaga gagttgcgaa 120  |
| gcaggttttg | gaggagagag tttgaagctg caaagtgggt ttcattgaaat caaaggttta 180 |
| gaggatgcga | ttgatttgtt cagtacatg ctctgatctc gtcctttacc ttctgtggtt 240   |
| gatttctgta | aattgatggg tgtgggtggg agaatggaac gcccgatct tgtgatttct 300   |
| ctctatcara | agatggaaag gaaacagatt csatgtgatr tatacagctt yaatattctg 360  |
| ataaaatgtt | tctgcagytg ctctaagcty ccctttgctt tgtctacatt tggtaagmtc 420  |
| accaagcttg | gactccaccc tgatgttgyt acctcamca ccctgctcca yggatttrtgy 480  |
| stkgawraka | gggtttctga agcyttgrat tktttcatc aaatgtttga aacgacatgt 540   |
| aggccsaayr | tcrtaacstt yaccackytg atgaacggtc tttgcyrca gggtagartt 600   |
| gtcgaagcyg | tagctctgct tgatcggatg mtrgaagatg gtctccagcc trmccagatt 660  |
| acttayggaa | caatygtaga ygggatgtgt aagawgggag ayactgtgtc tgcaytgaat 720  |
| ctkctgagga | agatggagga gktgagccac atcawaccca atgtkgtaat ctatagtgcm 780  |
| atcattgata | gcctttgtaa agacggacgt catagcgatg cacaaaatct tttactgaa 840   |
| atgcaagaga | aaggaatctt tcccgattta ttacctaca acagtatgat agttggtttt 900   |
| tgtagctctg | gtagatggag cgacgcggag cagttgttgc aagaaatgtt agaaaggaag 960  |
| atcagccctg | atgttgtaac ttataatgct ttgatcaatg catttgtcaa ggaaggcaag 1020 |

|            |            |            |            |             |            |      |
|------------|------------|------------|------------|-------------|------------|------|
| ttctttgagg | ctgaagaatt | atacgatgag | atgcttccaa | ggggtataat  | ccctaataca | 1080 |
| atcacatata | gttcaatgat | cgatggattt | tgcaaacaga | atcgtcttga  | tgctgctgag | 1140 |
| cacatgtttt | atttgatggc | taccaagggc | tgctctccca | acctaatacac | tttcaatact | 1200 |
| ctcatagacg | gatattgtgg | ggctaagagg | atagatgatg | gaatggaact  | tctccatgag | 1260 |
| atgactgaaa | caggattagt | tgctgacaca | actacttaca | acactcttat  | tcacgggttc | 1320 |
| tatctgggtg | gcgatcttaa | tgctgctcta | gaccttttac | aagagatgat  | ctctagtgg  | 1380 |
| ttgtgccctg | atatcgttac | ttgtgacact | ttgctggatg | gtctctgcga  | taatgggaaa | 1440 |
| ctaaaagatg | cattggaaat | gtttaagggt | atgcagaaga | gtaagaagga  | tcttgatgct | 1500 |
| agtcaccctt | tcaatggtgt | ggaacctgat | gttcaaactt | acaatatatt  | gatcagcggc | 1560 |
| ttgatcaatg | aagggaagtt | tttagaggcc | gaggaattat | acgaggagat  | gccccacagg | 1620 |
| ggatatagtc | cagatactat | cacctatagc | tcaatgatcg | atggattatg  | caagcagagc | 1680 |
| cgcctagatg | aggctacaca | aatgtttgat | tcgatgggta | gcaagagctt  | ctctccaaac | 1740 |
| gtagtgacct | ttactacact | cattaatggc | tactgtaagg | caggaagggt  | tgatgatggg | 1800 |
| ctggagcttt | tctgcgagat | gggtcgaaga | gggatagttg | ctaacgcaat  | tacttacatc | 1860 |
| actttgattt | gtggttttcg | taaagtgggt | aatattaatg | gggctctaga  | cattttccag | 1920 |
| gagatgattt | caagtgggtg | gtatcctgat | accattacca | tccgcaatat  | gctgactgg  | 1980 |
| ttatggagta | aagaggaact | aaaaagggca | gtggcaatgc | ttgagaaact  | gcagatgagt | 2040 |
| atggatctat | catttggggg | atga       |            |             |            | 2064 |

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<211> 2064

<212> DNA

<213> Raphanus

<400> 25

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| ttgttctgta | cgagatcgat | tcgtgatact  | ctggccaagg | caagcggaga | gagttgcgaa  | 120 |
| gcaggttttg | gaggagagag | tttgaagctg  | caaagtgggt | ttcatgaaat | caaaggttta  | 180 |
| gaggatgcca | ttgatttggt | cagtgcacatg | cttcgatctc | gtcctttacc | ttctgtgggt  | 240 |
| gatttctgta | aattgatggg | tgtgggtgtg  | agaatggaac | gcccggatct | tgtgatttct  | 300 |
| ctctatcaga | agatggaaa  | gaaacagatt  | cgatgtgata | tatacagctt | caatattctg  | 360 |
| ataaaatgtt | tctgcagctg | ctctaagctc  | ccctttgctt | tgtctacatt | tggttaagmtc | 420 |
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Leu Asn Leu Leu Arg Lys Met Glu Glu Xaa Ser His Ile Xaa Pro Asn  
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His Ser Asp Xaa Gln Asn Leu Phe Thr Glu Met Gln Glu Lys Gly Ile  
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Pro Xaa Xaa Val Thr Cys Xaa Thr Leu Leu Asp Gly Leu Cys Asp Asn  
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495

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Lys Ala Ser Xaa Xaa Gly Glu Ser Cys Glu Ala Gly Phe Gly Gly Glu  
35 40 45

Ser Leu Lys Leu Gln Ser Gly Phe His Glu Ile Lys Gly Leu Glu Asp  
50 55 60

Ala Ile Asp Leu Phe Ser Asp Met Leu Arg Ser Arg Pro Leu Pro Ser  
65 70 75 80

Val Val Asp Phe Cys Lys Leu Met Gly Val Val Val Arg Met Xaa Arg  
85 90 95

Pro Asp Xaa Val Ile Ser Leu Xaa Xaa Lys Met Glu Xaa Xaa Xaa Ile  
100 105 110

Xaa Cys Asp Xaa Tyr Ser Phe Asn Ile Leu Ile Lys Cys Phe Cys Ser  
115 120 125

Cys Ser Lys Leu Pro Phe Ala Leu Ser Thr Phe Gly Lys Xaa Thr Lys  
130 135 140

Leu Gly Leu His Pro Asp Val Val Thr Phe Thr Thr Leu Leu His Gly  
145 150 155 160

Leu Cys Val Glu Xaa Arg Xaa Ser Glu Ala Leu Xaa Xaa Phe His Gln  
165 170 175

Met Phe Glu Thr Thr Cys Arg Pro Asn Val Val Thr Phe Thr Thr Leu  
180 185 190

Met Asn Gly Leu Cys Arg Glu Gly Arg Ile Val Glu Ala Val Ala Leu  
195 200 205

Leu Asp Arg Met Met Glu Asp Gly Leu Gln Pro Thr Gln Ile Thr Tyr  
210 215 220

Gly Thr Ile Val Asp Gly Met Cys Lys Lys Gly Asp Thr Val Ser Ala  
225 230 235 240

Leu Asn Leu Leu Arg Lys Met Glu Glu Val Ser His Ile Ile Pro Asn  
245 250 255

Val Val Ile Tyr Ser Ala Ile Ile Asp Ser Leu Cys Lys Asp Gly Arg  
260 265 270

His Ser Asp Xaa Gln Asn Leu Phe Thr Glu Met Gln Glu Lys Gly Ile  
275 280 285

Phe Pro Asp Leu Phe Thr Tyr Asn Xaa Met Ile Xaa Gly Phe Cys Ser  
290 295 300

Ser Gly Arg Trp Xaa Asp Ala Glu Gln Leu Leu Gln Glu Met Leu Glu  
305 310 315 320

Arg Lys Ile Ser Pro Asp Val Val Thr Tyr Asn Ala Leu Ile Asn Ala  
325 330 335

Phe Val Lys Glu Gly Lys Phe Phe Glu Ala Glu Glu Leu Tyr Asp Glu  
340 345 350

Met Leu Pro Arg Gly Ile Ile Pro Asn Thr Ile Thr Tyr Ser Ser Met  
355 360 365

Ile Asp Gly Phe Cys Lys Gln Asn Arg Leu Asp Ala Ala Glu His Met  
370 375 380

Phe Tyr Leu Met Xaa Thr Lys Gly Cys Ser Pro Xaa Xaa Xaa Thr Phe  
385 390 395 400

Asn Thr Leu Ile Asp Gly Tyr Xaa Gly Ala Lys Arg Ile Asp Asp Gly  
405 410 415

Met Glu Leu Leu His Glu Met Thr Glu Xaa Gly Leu Val Ala Xaa Thr  
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Xaa Thr Tyr Asn Thr Leu Ile His Gly Phe Xaa Xaa Val Gly Asp Leu  
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Xaa Ala Ala Leu Asp Leu Leu Xaa Glu Met Ile Ser Ser Gly Xaa Cys

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| 450   |  | 455 |  | 460         |
| Pro Xaa Xaa Val Thr Cys Xaa Thr Leu Leu Asp Gly Leu Cys Asp Asn |  |     |  |             |
| 465   |  | 470 |  | 475 480     |
| Gly Lys Leu Lys Asp Ala Xaa Glu Xaa Phe Lys Val Met Gln Lys Ser |  |     |  |             |
|   |  | 485 |  | 490 495     |
| Lys Xaa Asp Leu Asp Ala Ser His Pro Phe Asn Gly Val Glu Pro Asp |  |     |  |             |
|   |  | 500 |  | 505 510     |
| Val Gln Thr Tyr Asn Ile Leu Ile Ser Gly Leu Ile Asn Glu Gly Lys |  |     |  |             |
|   |  | 515 |  | 520 525     |
| Phe Leu Glu Ala Glu Glu Leu Tyr Xaa Glu Met Pro His Arg Gly Ile |  |     |  |             |
|   |  | 530 |  | 535 540     |
| Val Pro Asp Thr Ile Thr Tyr Ser Ser Met Ile Asp Gly Leu Cys Lys |  |     |  |             |
|   |  | 545 |  | 550 555 560 |
| Gln Ser Arg Leu Asp Glu Ala Thr Gln Met Phe Asp Ser Met Gly Ser |  |     |  |             |
|   |  | 565 |  | 570 575     |
| Lys Ser Phe Ser Pro Asn Val Val Thr Phe Thr Thr Leu Ile Xaa Gly |  |     |  |             |
|   |  | 580 |  | 585 590     |
| Tyr Cys Lys Ala Gly Arg Val Asp Asp Gly Leu Glu Leu Phe Cys Glu |  |     |  |             |
|   |  | 595 |  | 600 605     |
| Met Gly Arg Arg Gly Ile Val Ala Asn Xaa Ile Thr Tyr Ile Thr Leu |  |     |  |             |
|   |  | 610 |  | 615 620     |
| Ile Xaa Gly Phe Arg Xaa Val Gly Asn Ile Asn Gly Ala Leu Asp Ile |  |     |  |             |
|   |  | 625 |  | 630 635 640 |
| Phe Gln Glu Met Ile Ser Ser Gly Val Tyr Pro Xaa Xaa Ile Thr Ile |  |     |  |             |
|   |  | 645 |  | 650 655     |
| Arg Xaa Met Leu Thr Gly Leu Trp Ser Lys Glu Glu Leu Lys Arg Xaa |  |     |  |             |
|   |  | 660 |  | 665 670     |
| Val Ala Met Leu Glu Xaa Leu Gln Met Ser Xaa Xaa Xaa Xaa Xaa Xaa |  |     |  |             |
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| Met | Leu | Ala | Arg | Val | Cys | Gly | Phe | Lys | Cys | Ser | Ser | Ser | Pro | Ala | Glu |
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Ser Ala Ala Arg Leu Phe Cys Thr Arg Ser Ile Arg Asp Thr Leu Ala  
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Lys Ala Ser Gly Glu Ser Cys Glu Ala Gly Phe Gly Gly Glu Ser Leu  
35 40 45

Lys Leu Gln Ser Gly Phe His Glu Ile Lys Gly Leu Glu Asp Ala Ile  
50 55 60

Asp Leu Phe Ser Asp Met Leu Arg Ser Arg Pro Leu Pro Ser Val Val  
65 70 75 80

Asp Phe Cys Lys Leu Met Gly Val Val Val Arg Met Glu Arg Pro Asp  
85 90 95

Leu Val Ile Ser Leu Tyr Gln Lys Met Glu Arg Lys Gln Ile Xaa Cys  
100 105 110

Asp Xaa Tyr Ser Phe Asn Ile Leu Ile Lys Cys Phe Cys Ser Cys Ser  
115 120 125

Lys Leu Pro Phe Ala Leu Ser Thr Phe Gly Lys Xaa Thr Lys Leu Gly  
130 135 140

Leu His Pro Asp Val Xaa Thr Phe Xaa Thr Leu Leu His Gly Leu Cys  
145 150 155 160

Xaa Xaa Xaa Arg Val Ser Glu Ala Leu Xaa Xaa Phe His Gln Met Phe  
165 170 175

Glu Thr Thr Cys Arg Pro Asn Xaa Xaa Thr Phe Thr Thr Leu Met Asn  
180 185 190

Gly Leu Cys Xaa Glu Gly Arg Xaa Val Glu Ala Val Ala Leu Leu Asp  
195 200 205

Arg Met Xaa Glu Asp Gly Leu Gln Pro Xaa Gln Ile Thr Tyr Gly Thr  
210 215 220

Ile Val Asp Gly Met Cys Lys Xaa Gly Asp Thr Val Ser Ala Leu Asn  
225 230 235 240

Leu Leu Arg Lys Met Glu Glu Xaa Ser His Ile Xaa Pro Asn Val Val  
245 250 255

Ile Tyr Ser Ala Ile Ile Asp Ser Leu Cys Lys Asp Gly Arg His Ser  
260 265 270

Asp Ala Gln Asn Leu Phe Thr Glu Met Gln Glu Lys Gly Ile Phe Pro  
275 280 285

Asp Leu Phe Thr Tyr Asn Ser Met Ile Val Gly Phe Cys Ser Ser Gly  
290 295 300

Arg Trp Ser Asp Ala Glu Gln Leu Leu Gln Glu Met Leu Glu Arg Lys  
305 310 315 320

Ile Ser Pro Asp Val Val Thr Tyr Asn Ala Leu Ile Asn Ala Phe Val  
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Lys Glu Gly Lys Phe Phe Glu Ala Glu Glu Leu Tyr Asp Glu Met Leu  
340 345 350

Pro Arg Gly Ile Ile Pro Asn Thr Ile Thr Tyr Ser Ser Met Ile Asp  
355 360 365

Gly Phe Cys Lys Gln Asn Arg Leu Asp Ala Ala Glu His Met Phe Tyr  
370 375 380

Leu Met Ala Thr Lys Gly Cys Ser Pro Asn Leu Ile Thr Phe Asn Thr  
385 390 395 400

Leu Ile Asp Gly Tyr Cys Gly Ala Lys Arg Ile Asp Asp Gly Met Glu  
405 410 415

Leu Leu His Glu Met Thr Glu Thr Gly Leu Val Ala Asp Thr Thr Thr  
420 425 430

Tyr Asn Thr Leu Ile His Gly Phe Tyr Leu Val Gly Asp Leu Asn Ala  
435 440 445

Ala Leu Asp Leu Leu Gln Glu Met Ile Ser Ser Gly Leu Cys Pro Asp  
450 455 460

Ile Val Thr Cys Asp Thr Leu Leu Asp Gly Leu Cys Asp Asn Gly Lys  
465 470 475 480

Leu Lys Asp Ala Leu Glu Met Phe Lys Val Met Gln Lys Ser Lys Lys  
485 490 495

Asp Leu Asp Ala Ser His Pro Phe Asn Gly Val Glu Pro Asp Val Gln

500

505

510

Thr Tyr Asn Ile Leu Ile Ser Gly Leu Ile Asn Glu Gly Lys Phe Leu  
 515 520 525

Glu Ala Glu Glu Leu Tyr Glu Glu Met Pro His Arg Gly Ile Val Pro  
 530 535 540

Asp Thr Ile Thr Tyr Ser Ser Met Ile Asp Gly Leu Cys Lys Gln Ser  
 545 550 555 560

Arg Leu Asp Glu Ala Thr Gln Met Phe Asp Ser Met Gly Ser Lys Ser  
 565 570 575

Phe Ser Pro Asn Val Val Thr Phe Thr Thr Leu Ile Asn Gly Tyr Cys  
 580 585 590

Lys Ala Gly Arg Val Asp Asp Gly Leu Glu Leu Phe Cys Glu Met Gly  
 595 600 605

Arg Arg Gly Ile Val Ala Asn Ala Ile Thr Tyr Ile Thr Leu Ile Cys  
 610 615 620

Gly Phe Arg Lys Val Gly Asn Ile Asn Gly Ala Leu Asp Ile Phe Gln  
 625 630 635 640

Glu Met Ile Ser Ser Gly Val Tyr Pro Asp Thr Ile Thr Ile Arg Asn  
 645 650 655

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20 25 30

Lys Ala Ser Gly Glu Ser Cys Glu Ala Gly Phe Gly Gly Glu Ser Leu  
35 40 45

Lys Leu Gln Ser Gly Phe His Glu Ile Lys Gly Leu Glu Asp Ala Ile  
50 55 60

Asp Leu Phe Ser Asp Met Leu Arg Ser Arg Pro Leu Pro Ser Val Val  
65 70 75 80

Asp Phe Cys Lys Leu Met Gly Val Val Val Arg Met Glu Arg Pro Asp  
85 90 95

Leu Val Ile Ser Leu Tyr Gln Lys Met Glu Arg Lys Gln Ile Arg Cys  
100 105 110

Asp Ile Tyr Ser Phe Asn Ile Leu Ile Lys Cys Phe Cys Ser Cys Ser  
115 120 125

Lys Leu Pro Phe Ala Leu Ser Thr Phe Gly Lys Xaa Thr Lys Leu Gly  
130 135 140

Leu His Pro Asp Val Val Thr Phe Thr Thr Leu Leu His Gly Leu Cys  
145 150 155 160

Val Glu Asp Arg Val Ser Glu Ala Leu Xaa Xaa Phe His Gln Met Phe  
165 170 175

Glu Thr Thr Cys Arg Pro Asn Val Val Thr Phe Thr Thr Leu Met Asn  
180 185 190

Gly Leu Cys Arg Glu Gly Arg Ile Val Glu Ala Val Ala Leu Leu Asp  
195 200 205

Arg Met Met Glu Asp Gly Leu Gln Pro Thr Gln Ile Thr Tyr Gly Thr  
210 215 220

Ile Val Asp Gly Met Cys Lys Lys Gly Asp Thr Val Ser Ala Leu Asn  
225 230 235 240

Leu Leu Arg Lys Met Glu Glu Val Ser His Ile Ile Pro Asn Val Val  
245 250 255

Ile Tyr Ser Ala Ile Ile Asp Ser Leu Cys Lys Asp Gly Arg His Ser  
260 265 270

Asp Ala Gln Asn Leu Phe Thr Glu Met Gln Glu Lys Gly Ile Phe Pro  
275 280 285

Asp Leu Phe Thr Tyr Asn Ser Met Ile Val Gly Phe Cys Ser Ser Gly  
290 295 300

Arg Trp Ser Asp Ala Glu Gln Leu Leu Gln Glu Met Leu Glu Arg Lys  
305 310 315 320

Ile Ser Pro Asp Val Val Thr Tyr Asn Ala Leu Ile Asn Ala Phe Val  
325 330 335

Lys Glu Gly Lys Phe Phe Glu Ala Glu Glu Leu Tyr Asp Glu Met Leu  
340 345 350

Pro Arg Gly Ile Ile Pro Asn Thr Ile Thr Tyr Ser Ser Met Ile Asp  
355 360 365

Gly Phe Cys Lys Gln Asn Arg Leu Asp Ala Ala Glu His Met Phe Tyr  
370 375 380

Leu Met Ala Thr Lys Gly Cys Ser Pro Asn Leu Ile Thr Phe Asn Thr  
385 390 395 400

Leu Ile Asp Gly Tyr Cys Gly Ala Lys Arg Ile Asp Asp Gly Met Glu  
405 410 415

Leu Leu His Glu Met Thr Glu Thr Gly Leu Val Ala Asp Thr Thr Thr  
420 425 430

Tyr Asn Thr Leu Ile His Gly Phe Tyr Leu Val Gly Asp Leu Asn Ala  
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Ile Val Thr Cys Asp Thr Leu Leu Asp Gly Leu Cys Asp Asn Gly Lys  
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Leu Lys Asp Ala Leu Glu Met Phe Lys Val Met Gln Lys Ser Lys Lys  
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Thr Tyr Asn Ile Leu Ile Ser Gly Leu Ile Asn Glu Gly Lys Phe Leu  
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Glu Ala Glu Glu Leu Tyr Glu Glu Met Pro His Arg Gly Ile Val Pro  
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Arg Leu Asp Glu Ala Thr Gln Met Phe Asp Ser Met Gly Ser Lys Ser  
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Phe Ser Pro Asn Val Val Thr Phe Thr Thr Leu Ile Asn Gly Tyr Cys  
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Lys Ala Gly Arg Val Asp Asp Gly Leu Glu Leu Phe Cys Glu Met Gly  
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Gly Phe Arg Lys Val Gly Asn Ile Asn Gly Ala Leu Asp Ile Phe Gln  
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Glu Met Ile Ser Ser Gly Val Tyr Pro Asp Thr Ile Thr Ile Arg Asn  
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